Piston for an internal combustion engine and casting method for its production

The invention relates to a piston for an internal combustion engine in accordance with the preamble of claim 1, and a method for its production, in accordance with the preamble of claim 3.

A piston is known from the *Offenlegungsschrift* DE 199 22 809 A1, having pin bosses molded onto a cylindrically configured upper region of the piston, which are recessed as compared with the edge of the upper region, so that when the piston is cast, recesses can be formed in the underside of the overhang formed thereby, close to the pin bosses. For this purpose, a casting mold is used that contains a pivoting window insert having one casting core per recess, but this can only produce those recesses from which the casting core can easily be pulled out after casting.

Proceeding from this, the invention is based on the problem of forming recesses having undercuts in the underside of the upper region of the piston, when casting a piston using a pivoting window insert, in order to thereby reduce the weight of the

piston as much as possible, and also to move its center of gravity into the lower region of the piston as much as possible.

This problem is solved with the characteristics contained in the characterizing part of the main claim and of claim 3.

Practical embodiments of the invention are the object of the dependent claims.

In this connection, the advantages of a pivoting window insert with which recesses can be produced in simple manner, in terms of casting technology, for which slides that can be moved in linear manner are unsuitable, are combined with the advantages of a salt core, which offers an unlimited potential of possibilities of configuring cavities in pistons.

An exemplary embodiment of the invention will be described below, using the drawings. These show:

Fig. 1 a piston in partial cross-section, after casting, with the salt mold part inserted, attached to a pivoting window insert,

Fig. 2 the piston with the salt mold part inserted, and the window insert, which has come loose from the salt mold part, pivoted out,

Fig. 3 the piston in partial cross-section, after the salt mold part has been washed out, and

Fig. 4 a view of the piston according to the invention from below.

In Fig. 1, a piston 1 is shown in half cross-section, the left half of which shows a cross-section of the piston lying on the longitudinal axis 2 of a piston pin, not shown, and the right half of which shows a side view of the piston 1, in which a coated region 3 of a piston skirt 4 can be seen. The piston 1 is configured as a box-type piston, i.e. a lower region 6 that has an approximately box-shaped cross-section is located below an upper region 5 in the shape of a circular cylinder, which accommodates the piston rings; in the former, the bosses 7 and the box walls in the region of the bosses 7 are drawn in towards the central piston axis 8, and only the skirt wall sections that lie in the region of the major thrust side and the minor thrust side have the shape, in cross-section, of segments of a circle whose diameter corresponds to the piston diameter.

The piston 1 has two raised regions 9 and 10, which are disposed on the two sides of a combustion chamber bowl 11 molded into the piston head. To ensure that these raised regions 9 and 10 do not displace the center of gravity of the piston 1 too far upward in the direction of the combustion chamber bowl 11, during casting of the piston 1, recesses 12 that are open towards the lower region 6 of the piston 1 are formed in the combustion chamber bowls 9, 10, and furthermore undercuts 13 are formed in the region between the bosses 7 and the upper region 5, which are configured to be nose-shaped in the present exemplary embodiment and are oriented towards the central piston axis 8, in each instance, but which can also have a different shape that is suitable for reducing the weight of the piston. Furthermore, the center of gravity of the piston 1 is moved in the direction of the bosses 7 by means of the material that is saved in this connection.

Here, the casting mold for casting the piston 1 has a pivoting window insert 14 for each of the recesses 12 to be produced in the two raised regions 9 and 10. In order to be able to mold the undercuts 13 in the upper region 5 of the piston 1 with this insert, a pre-finished salt mold part 15 is applied to the window insert 14 before the piston 1 is cast; the shape of this mold part is identical with the shape of the recess 12, including the

undercut 13. The salt mold part 15 is attached to the window insert 14, so as not to rotate, by way of two cone-shaped extensions 16 that are disposed on the window insert 14 onto which the salt mold part 15 is set. In Figures 1 and 2, the window insert 14 is shown in cross-section, and for this reason only one of the two extensions 16 can be seen. The piston blank 1 is cast with the window insert 14 pivoted in and the salt mold part 15 attached to it.

Subsequent to the casting process, according to Figure 2, the window insert 14 is pivoted clockwise, at the same time as the rest of the casting mold, not shown in the figures, is opened, whereby the salt mold part 15 is released from the window insert 14 and remains in the piston blank 1, in order to subsequently be washed out.

In this connection, the piston blank 1 shown in Figure 3 is formed, which has the recesses 12 with the undercuts 13, whereby these recesses 12, as also shown in Figure 4, are divided by ribs 17, 17', which serve to improve the shape stability of the walls 18 of the raised regions 9 and 10. This allows configuring the walls 18 to be very thin, in order to thereby achieve improved cooling of the upper region 5 of the piston 1 by means of spraying it with cooling oil.

The view of the piston from below, according to Figure 4, shows the kidney-shaped configuration of the recesses 12, 12', with the undercuts 13, 13' shown with broken lines, which undercuts are divided by two ribs 17, 17', in each instance, in the present exemplary embodiment. In the production of the salt mold part 15 used here, the shape and the arrangement of the ribs 17, 17' can be taken into consideration in simple manner, by means of a corresponding configuration of the salt mold part 15. In the exemplary embodiment shown, the shape of the salt mold part 15 corresponds to the negative mold of the recesses 12, 12' and the undercuts 13, 13'. In this connection, Figures 1 and 2 show cross-sectional representations of the salt mold part 15, which is configured in one piece and has indentations for forming the ribs 17, 17' shown in Figures 3 and 4, which indentations correspond in their shape and depth to the ribs 17 according to Figure 3, and the arrangement of which corresponds to the arrangement of the ribs 17, 17' according to Figure 4.

Reference Symbol List

1	piston, piston blank
2	piston axis
3	coated region
4	piston skirt
5	upper region
6	lower region
7	boss
8	central piston axis
9	lateral raised region
10	lateral raised region
11	combustion chamber bowl
12, 12′	recess
13, 13′	undercut
14	window insert
15	salt mold part
16	cone-shaped extension
17, 17′	ribs
18	wall